

1 **CLAIMS**

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3 1) A Vertical External Cavity Surface Emitting Laser
4 comprising: a semiconductor wafer structure,
5 containing a gain medium and a Bragg reflecting
6 region; and a heatspreader associated with the wafer
7 structure such that the gain medium is located
8 between the heatspreader and the Bragg reflecting
9 region, wherein the heatspreader comprises a non-
10 birefringent material.

11

12 2) A laser as claimed in Claim 1 wherein the
13 heatspreader comprises a first surface upon which is
14 located an anti-reflection coating.

15

16 3) A Vertical External Cavity Surface Emitting Laser
17 comprising: a semiconductor wafer structure
18 containing a gain medium and a Bragg reflecting
19 region; and a heatspreader associated with the wafer
20 structure such that the gain medium is located
21 between the heatspreader and the Bragg reflecting
22 region, wherein the heatspreader comprises a first
23 surface upon which is located an anti-reflection
24 coating.

25

26 4) A laser as claimed in Claim 3 wherein the
27 heatspreader comprises a non-birefringent material.

28

29 5) A laser as claimed in any of Claims 2 to 4 wherein
30 the anti-reflection coating is optimised for
31 efficient operation with a refractive index of the
32 non-birefringent material and a lasing frequency of
33 the laser.

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2 6) A laser as claimed in any of Claims 2 to 5 wherein
3 the first surface of the heatspreaders comprise a
4 wedge.

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6 7) A laser as claimed in any of the preceding claims
7 wherein the heatspreaders comprises a single diamond
8 crystal.

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10 8) A laser as claimed in any of the preceding claims
11 wherein lasing is achieved by optical excitement of
12 the gain medium.

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14 9) A laser as claimed in any of claims 1 to 7 wherein
15 lasing is achieved by electrical excitement of the
16 gain medium.

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18 10) A laser as claimed in any of the preceding claims
19 wherein the laser further comprises an intracavity
20 polarisation selecting element that provides a first
21 means for selecting the operating frequency of the
22 laser.

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24 11) A laser as claimed in Claim 10 wherein the
25 intracavity polarisation selecting element comprises
26 a birefringent filter orientated at Brewster's angle.

27

28 12) A laser as claimed in any of the preceding claims
29 wherein the laser further comprises an intracavity
30 etalon that provides a second means for selecting the
31 operating frequency of the laser.

32

1 13) A laser as claimed in any of the preceding claims
2 wherein the laser further comprises an external
3 reference cavity that allows for the frequency
4 stabilisation of the laser output to a side of a
5 transmission peak of the external cavity.

6

7 14) A laser as claimed in any of the preceding claims
8 wherein the laser comprises a three mirror folded
9 cavity arrangement.

10

11 15) A laser as claimed in Claim 14 wherein the laser
12 further comprises a cavity mirror mounted on a first
13 piezoelectric crystal and an output coupler mounted
14 on a second piezoelectric crystal wherein the
15 combined movement of the cavity mirror and the output
16 coupler provides a first means for frequency tuning
17 the output of the laser.

18

19 16) A laser as claimed in Claim 14 or 15 wherein the
20 laser further comprises a pair of Brewster plates and
21 a cavity mirror mounted on a piezoelectric crystal
22 wherein the combined movement of the Brewster plates
23 and the cavity mirror provide a second means for
24 frequency tuning the output of the laser.

25

26 17) A frequency scanning Vertical External Cavity Surface
27 Emitting Laser suitable for use in high resolution
28 spectroscopy experiments comprising: apparatus for
29 selecting and stabilising the operating frequency of
30 the laser; apparatus for scanning the operating
31 frequency of the laser; a semiconductor wafer
32 structure containing a gain medium and a Bragg
33 reflecting region; and a heatspreader associated with

1 the wafer structure such that the gain medium is
2 located between the heatspreader and the Bragg
3 reflecting region, wherein the heatspreader comprises
4 a non-birefringent material.

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6 18) A laser as claimed in Claim 17 wherein the
7 heatspreader comprises a first surface upon which is
8 located an anti-reflection coating.

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10 19) A laser as claimed in Claim 17 or 18 wherein the
11 apparatus for selecting and stabilising the operating
12 frequency of the laser comprises an intracavity
13 polarisation selecting element that provides a first
14 means for selecting the operating frequency of the
15 laser

16

17 20) A laser as claimed in Claim 19 wherein the apparatus
18 for selecting and stabilising the operating frequency
19 of the laser further comprises an intracavity etalon
20 that provides a second means for selecting the
21 operating frequency of the laser.

22

23 21) A laser as claimed in Claim 20 wherein the apparatus
24 for selecting and stabilising the operating frequency
25 of the laser further comprises an external reference
26 cavity that allows for the frequency stabilisation of
27 the laser output to a side of a transmission peak of
28 the external cavity.

29

30 22) A laser as claimed in any of claims 17 to 21 wherein
31 the apparatus for scanning the operating frequency of
32 the laser comprises a cavity mirror mounted on a
33 first piezoelectric crystal and an output coupler

1 mounted on a second piezoelectric crystal wherein the
2 combined movement of the cavity mirror and the output
3 coupler provides a first means for tuning the
4 frequency output of the laser.

5

6 23) A laser as claimed in any of claims 17 to 22 wherein
7 the apparatus for scanning the operating frequency of
8 the laser comprises a pair of Brewster plates and a
9 cavity mirror mounted on a piezoelectric crystal
10 wherein the combined movement of the Brewster plates
11 and the cavity mirror provides a second means for
12 tuning the frequency output of the laser.

13

14 24) A laser as claimed in any of claims 18 to 23 wherein
15 the anti-reflection coating is optimised for
16 efficient operation with a refractive index of the
17 non-birefringent material and a lasing frequency of
18 the laser.

19

20 25) A laser as claimed in any of claims 17 to 24 wherein
21 the first surface of the heatspreader comprise a
22 wedge.

23

24 26) A laser as claimed in any of claims 17 to 25 wherein
25 the heatspreader comprises a single diamond crystal.